From: (b) (6)

Sent: Tuesday, September 06, 2016 4:58 PM

To: HarborComments

Subject: Proposed Plan Comments

Attachments: Proposed Plan Comments (b) (6)

Comment on EPA's Proposed Cleanup Plan for the Portland Harbor Superfund Site

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I am an environmental scientist with over 26 years of experience working at contaminated sites and the former chair of ABA's Superfund and NRD Committee.

I know others are preparing comments that will raise many technical and legal issues with the Portland Harbor Proposed Plan. My comments focus specifically on the misapplication of Arnot and Gobas's (2004)[1] food web model to develop remedial goals and the failure to consider background fish tissue concentration in setting targets.

My key concerns are:

- While commonly used, food web models have not been shown to be able to accurately predict post remediation concentrations, so are not appropriate for setting sediment remedial goals.
- At Portland Harbor, the food web model was not run in a way that would be able to predict post remediation concentrations.
- Critical hypothesis, assumptions, and conclusions of the model were never tested.
- The calibration and validation approach used provides no evidence that the model can predict post remediation tissue concentrations.
- Fish collected over most of the Portland Harbor site have fish tissue concentrations that are consistent with non-urban stretches of larger Northwest rivers, including the Upper Willamette, but that exceed risk based goals.
- Sediment remediation is unlike to reduce fish tissue concentrations over much of the site.
- Sediment remediation will not result in targeted fish tissue concentrations.

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Application of a food web model to set sediment PRGs.

As noted on page 23 of the proposed plan, sediment concentrations needed to meet protective fish and shellfish tissue concentrations (FTC) were estimated using a food-web model (FWM) calibrated to predict COC concentrations in fish based on the concentration in sediment. While EPA suggests that FWM calibrated under current conditions can be used to predict post-remediation FTC, they did not try to test this hypothesis. Although this is not the first site to use

[1] Arnot, J. A. and Gobas, F. A. P. C. 2004. A food web bioaccumulation model for organic chemicals in aquatic ecosystems. Environmental Toxicology and Chemistry, 23: 2343–2355. doi:10.1897/03-438

FWMs for the purpose of setting remedial goals, the validly of the approach has not been confirmed with adequate post remediation testing. Given the modeling approach used, the likelihood that EPA has the ability to accurately predict future FTCs at Portland Harbor is extremely low.

Using the model as a predictive tool is based on the inconsistent logic that the model is useful because it can characterize condition specific factors, but once characterized; these factors will remain constant even as site conditions are significantly modified due to remediation. In application, there is rarely any evidence that the relationships between chemical concentrations in sediment, water, and biota measured under pre-remediation conditions can be used to accurately predict relationships under much lower sediment concentrations. Because bioaccumulations factors can be concentration dependent, models may have little predictive power since management alternatives are generally intended to result in concentrations below those that used in calibration. As noted by Gustavson et al (2011)[2], even though aspects of the science underlying food web models is fairly well understood, there is substantial uncertainty associated with predicting future conditions, particularly when these predictions incorporate the impact of remedial technologies on contaminant exposures. Gustavson et al (2011) is an excellent review written by Corp of Engineer experts on the limitation of applying food web models at Superfund sites.

EPA is using Arnot and Gobas's FWM at Portland Harbor. The model was developed to improve the understanding of bioaccumulation in aquatic ecosystems under steady state conditions, not to predict post-remediation FTCs. It may answers why things are the way they are, but does not explain how thing will be under different conditions. There are a number of critical assumptions concerning the models application that have not been sufficiently tested at Portland Harbor. One is that sediment is the sole or primary source of contaminants found in fish.

The model is summarized in Equation B1-5 from the FS which is the same as Equation 2 in Arnot and Gobas's (2004).

$$C_B = \frac{k_1 \times \left(m_O \times C_{WD,O} + m_P \times C_{WD,P}\right) + k_D \times \sum P_i \times C_{D,i}}{k_2 + k_E + k_G + k_M} \qquad \text{Equation B1-5}$$

The equation links fish tissue concentration (Cb) to three other environmental concentrations, surface water (Cwd,o), sediment pore water (Cwd,p), and prey species tissue (Cd). The equation assumes about 10 constants can be relate these four concentrations at steady state. It is important to note that while sediment pore water is one of the equation inputs, sediment concentration (Cs)

[2] Gustavson K., von Stackelberg T. and Igor Linkov I. 2011. Bioaccumulation Models: State of the Application at Large Superfund Sites. ERDC TN-DOER-R17. U.S. Army Corps of Engineers, Engineering Research and Development Center. Vicksburg, MS.

is not. It is well known that the relationship between sediment and pore water concentrations can vary over orders of magnitude at a single site. Research conducted by the State of Oregon[3] and OSU[4] have suggested that sources other than sediment are responsible for most of the dissolved PCBs found at in the Willamette River.

EPA's use of the model requires that FTC is a function of sediment concentration so that knowledge of one can be used to calculate the other. An equation for such a relationship would be FTC is a function of sediment concentration or:

$$Cb = \int Cs \qquad \text{Equation 1}$$

But because of three potentially independent concentrations, Equation B1-5 cannot be simplified to Equation 1 but is more accurately represented by:

$$Cb = \int \int \int (Cwd,o;\ Cwd,s;\ Cd) \qquad \text{Equation 2}$$

While it might be possible to solve this equation empirically using sufficient data collected over ranges of the four critical concentrations, it cannot be calculated at steady state or by comparing only a site wide mean FTC to an site wide average sediment concentration (SWAC).

Application Equation B1-5 requires many more equations and assumed variables. Taken from a report summarizing the same approach at the Duwamish River CERCLA site[5], Figure 1 summarizes the complexity of the modeling effort. While the complexity may provide a semblance of validity, it actually hides the uncertainty and weakness in approach.

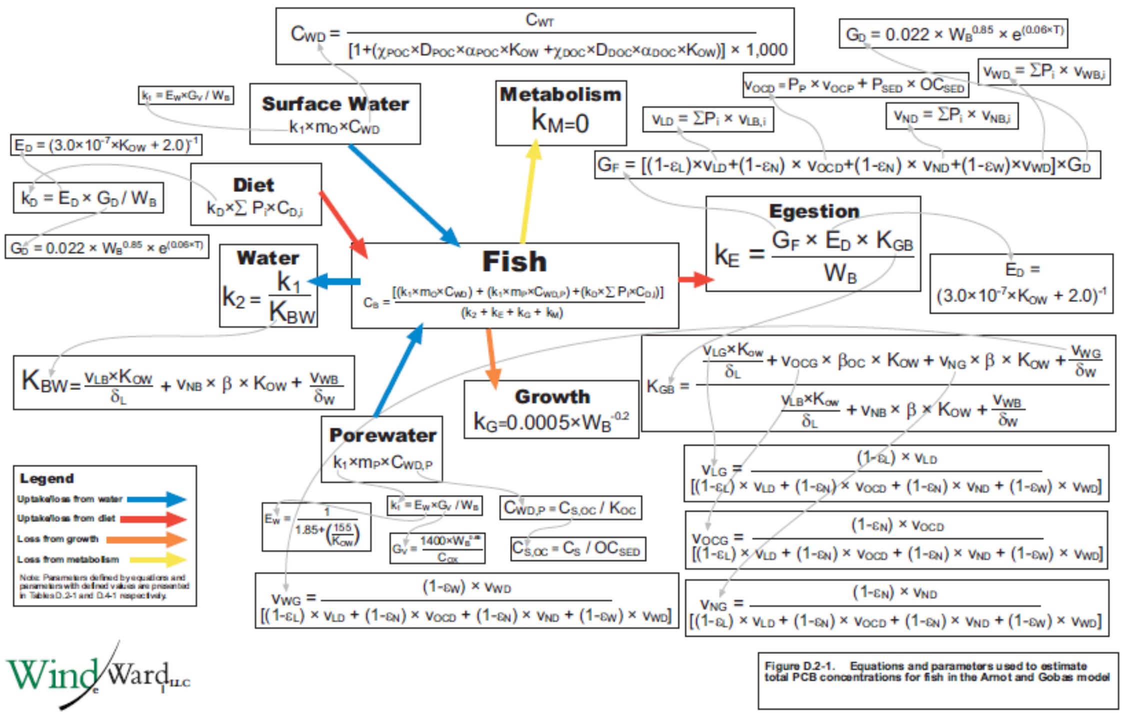
As described in the FS, the specific modeling details are difficult to follow. It seems that the modelers used only a single tissue concentration per species and a single SWAC. Even though the goal was to understand the relationship between them, the modelers failed to use either as a calibration parameter. The argument that model shouldn't be run at various sediment concentrations because it is a "decision variable" makes no technical sense given the goal of this exercise is to predict the effect of a change in sediment concentration, and it citres to a paper that appears to have little to do with the topic.

[3] Hope, B. 2008. A Model for the Presence of Polychlorinated Biphenyls (PCBs) in the Willamette River Basin (Oregon). Environmental Science & Technology 42:5998-6006

[4] Sethajintanin, D, Johnson, ER, Loper, BR, Anderson, KA,2004,Bioaccumulation profiles of chemical contaminants in fish from the lower Willamette River, Portland Harbor, Oregon., Arch Environ Contam Toxicol

[5] Windward. 2010. Lower Duwamish Waterway Remedial Investigation Report. Windward Environmental LLC, Seattle, WA

Figure 1: Equations used in the Arnot and Gobas model (from Windward 2010)[5]



Monte Carlo simulation was used to try 50,000 of different combinations of plausible values for non-chemical-specific model input parameters. While this identified combinations of multiple parameters that purport to relate the input values of FTC and SWAC, it provides no support that any of the underlying assumptions are correct. Finding a few apparent fits in 50,000 tries given the numbers of degrees of freedom available with so many variables does not indicate that any specific output correct.

The validation step does not validate that the model is predictive. The model was calibrated and validate with pre-remediation data. The results say nothing about potential post remediation responses. If the purpose is to predict FTC at very low sediment concentrations, the model must be both calibrated and validated over a range that includes the target concentration.

If food web modeling is to be used to predict the effect of changing sediment concentrations on fish tissue concentrations:

- The effect of non-sediment sources must be considered.

- Modeling, calibration, and validation must be conducted over a range of sediment concentrations.
- Key assumptions need to tested and confirmed.
- Model predictions need to be confirmed using methods other than the model.

Regional Background Fish Tissue Concentrations

Target FTC for PCBs appear to be below regional background concentration for fish tissue concentrations. The issue of background FTC is not sufficiently discussed in the RI, FS, or Proposed Plan. I calculated regional background concentrations using data from non-urban northwest rivers and compared them to fish recently[6] collected from the Portland Harbor site. Oregon data was obtained from an article (Henney et al 2003)[7] that compiled data on fish collected from the Willamette River between mile 26 and 180 (Oregon City to Eugene). The results of samples collected upriver of Willamette Falls and reported in the Portland Harbor RI/FS were also used in this evaluation. Washington river fish data were obtained from a Washington State Department of Ecology (WDOE) report (Johnson 2001).[8]

Small Mouth Bass (SMB) is a focus in Portland Harbor. Henney did not include SMB data, so the results of the Northern Pikeminnow were used. The WDOE data included a number of fish species, including SMB, collected from 10 rivers primarily in eastern Washington. Samples known to be collected from an urban area, such as within Spokane, were excluded. Two samples with concentrations about 10x the other results were also excluded as potential outliers from the WDOE data set. In all cases, only whole fish results for total PCBs were used in the current evaluation.

EPA developed software, ProUCL[9], was used to calculate background fish tissue concentrations. Fifteen data points were available for the upper Willamette River and 23 were used for the Washington rivers. ProUCL reports the 90, 95, and 99 percent estimate of background concentrations. The 95% result means that 95% of background samples should be below this concentration, but 5% of background samples may exceed it. The calculated background fish tissues concentration for both state sample sets are in the range of $1x10^2$ to $1x10^3$ ug/kg total PCBs (Table 1). All the recent samples of SMB collected in Portland Harbor between river mile 4 and 7 are below the Washington 95% background concentration. The only exceedances were collected in areas of known PCB hotspots.

[6] Kennedy/Jenks, 2013. Portland Harbor RI/FS 2012 Smallmouth Bass Tissue Study. DRAFT Data Report. 03/13/13.

[7] Henney et al, 2003. Biomagnification factors (fish to osprey eggs from Willamette River, Oregon) for PCDDs, PCDFs, PCBs and OC pesticides. Environmental Monitoring and Assessment 84: 275–315.

[8] Johnson, 2001. An Ecological Hazard Assessment for PCBs in the Spokane River. WA Department of Ecology, Publication No. 01-03-015.

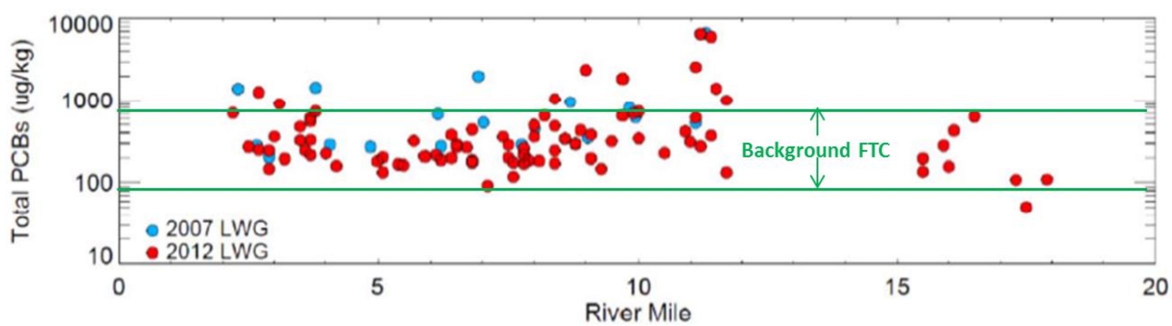
[9] EPA, 2011. ProUCL. http://www.epa.gov/osp/hstl/tsc/software.htm

Table 1: Calculated backgrounds of total PCBs (ug/kg) in whole fish tissue from above Willamette Falls and from ten Washington Rivers.

River	N	90%	95%	99%
Willamette	15	229	276	392
Washington	23	427	562	942

Figure 2 shows the individual 2012 SMB results from the LWG Portland Harbor study relative to the calculated 95% backgrounds concentrations. This evaluation suggests that the total PCB concentration of many SMB collected from within Portland Harbor are consistent with background concentrations for fish collected upriver of Willamette Falls or from other rural NW rivers. Background FTCs exceed EPA's risk based targets. The highest concentration of Portland Harbor sample exceeded calculated background by an order of magnitude. Remediation conducted below about mile 7 may have little effect on PCB tissue concentrations.

Figure 2: Individual SMB whole tissue total PCP results and calculated background concentrations for fish from the upper Willamette and rural Washington Rivers.



Recommendations

- Identify sources of PCB other than those released within the Portland Harbor that are important contributors to the PCBs found in Harbor fish tissue.
- Determine the relative contribution of all sources to the aqueous phase.
- Model areas of the site with different sediment concentrations separately.
- Test the assumption that the results are predictive at low sediment concentrations.
- Use measured, not modeled sediment pore water partitioning coefficients.
- Remember that the uncertainty ranges over orders of magnitude.

- Understand the issues and limitations raised in Gustavson et al 2011.
- Focus on risk reduction, not sediment remediation.

Conclusions

- The current target risk goals are currently exceeded in larger rivers Oregon and Washington and cannot be met.
- Remediation of the sediments in the Portland Harbor is unlikely to result in a reduction of fish tissue concentration below the calculated background concentrations.